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The Genera *Chiodecton*, *Dichosporidium*, *Graphidastra* and *Pulvinodecton* (Lichens) in Japan and Taiwan, with Notes on Certain Species-Rich Old-Growth Forests

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Chiodecton congestulum is reported from new localities in Japan and *C. asahinae* is reduced to a synonym of *C. congestulum*. *Dichosporidium boschianum* and *D. sorediatum* are reported as new to Japan and comprehensive information about the occurrence of *Pulvinodecton kurzii* in Japan is provided. *Dichosporidium boschianum* and *Graphidastra multiformis* are reported as new to Taiwan and *Erythrodecton malacum* is reported as new to Malaya in Malaysia. For each of these species, the occurrence of lichen substances and the distribution and habitat in Japan and Taiwan are discussed. All species have a southern subtropical/tropical distribution in Japan. The distribution within Japan of tropical lichens which also have scattered outlying localities in areas with a subtropical/temperate climate is discussed and found to coincide with the annul isothermal of 15 °C.

Key words: *Chiodecton*, *Dichosporidium*, *Graphidastra,* Japan, *Pulvinodecton.*

The material available to the author in his world revision of *Chiodecton* and five allied genera (Thor 1990) included only a single specimen of *Chiodecton congestulum* from Japan and Taiwan, respectively. Given, however, the widespread occurrence of these lichens in undisturbed subtropical to tropical rainforests of the world, it is not surprising that additional material has lately been detected from these countries during herbarium studies and field work in southern Japan in 1995 and 1997.

Material and Methods

Material was collected during one field trip to the Hiroshima area and Shikoku in January 1995, one field trip to the islands Amami-Oshima, Ishigaki-jima and Iriomote-jima in February 1995, and one field trip to Iriomote-jima in November 1997. The species were searched for also during field trips to other subtropical areas including Hachijo-jima, Yaku-shima and the Kagoshima/Kirishima area. Collections of *Chiodecton* in HIRO and TNS were also studied, and one collection each of *Dichosporidium boschianum*, *Erythrodecton malacum* and *Graphidastra multiformis* from Malaysia and Taiwan was found in TNS among undetermined material. Also included are one collection of *Chiodecton congestulum* in H and W, respectively.

In the following species accounts, the tree species (where known) on which the cited specimens were collected are given within parentheses after the collecting number. Measurements given in mm were made using a dissecting microscope. Light microscopy measurements used for statistical calculations were made with an oil immersion lens on water mounts, achieving a precision of 1 µm. The number of spores and conidia measured differ depending on their frequency, but 120 have been measured where possible. The minimum (min.) and maximum (max.) values of spore and conidia size represent the extreme measurements recorded: the measurements are given as (min.–) $\bar{X} \pm$ SD (–max.), where $\bar{X} \pm$ SD are rounded to the nearest whole number. The mean value ($\bar{X}$), the standard deviation (SD) and the total sample size (n) are given in parentheses. For the measurements of all other morphological characters, the values represent the extreme range. The iodine coloration (Lugol's solution; iodine concentration 0.25%) was studied both with and without pre-treatment with K; the former coloration is here denoted as the K/I coloration, the latter as the I coloration. Calcium oxalate was identified under the microscope by adding 25% H_2SO_4 under the cover slip, thus causing the crystals to dissolve and recrystallize as colourless, needle-shaped crystals of calcium sulphate. Thin layer chromatography (TLC) was carried out in accordance with the method described by White and James (1985).

In the list of specimens examined, the collections are arranged from north to south (specimens from Honshu from NE to SW). The names of the individual islands included here are not followed by "island", but instead by the Japanese word for island ("-shima", "-Oshima" or "-jima"). When referring to archipelagos, the names are followed by "Islands". The material collected by the author in 1995 is housed in TNS with duplicates in herbarium G. Thor. If nothing is stated under Specimens examined, the collections are corticolous.

Morphology and Anatomy

Information on morphology and anatomy given here is merely additional to earlier discussions by Thor (1990), Thor (1992), Henssen and Thor (1994), and Henssen and Thor (1998); for more thorough descriptions of the genera and species, the reader is referred to these publications. Some information on the morphology and anatomy is presented in order to point out differences between populations of the species in different regions. The spores of *Dichosporidium*, *Erythrodecton* and *Graphidastra* are fragile and easily broken in microscope mounts; caution must thus be taken when assessing their form and length. The hypothecium is here defined as the hyphal layer under the subhymenium (Hawksworth et al. 1983). Pseudoangiocarpic apothecia (Henssen and Thor 1994) have a punctiform to slightly elongated disc.

Lichen substances

Lichen substances provide useful diagnostic characters for distinguishing among the different genera and species. All *Chiodecton* species contain the fatty acid roccellic acid (and sometimes additional substances), whereas *Dichosporidium* contain different depsidones of the β-orcinol series (e.g., norstictic, protocetraric, salazinic acids), *Erythrodecton* contain roccellic and rhodocladonic acids and *Pulvinodecton* contain different para-depsides of the β-orcinol series (baeomysesic, barbatic, obtusatic, squamatic, 4-O-demethylbarbatic acids) and rhodocladonic acid. Both *Graphidastra* species contain roccellic acid whereas *G. multiformis* also produces protocetraric acid.

Habitat

All species are confined to humid, oldgrowth, subtropical/tropical forests at low altitudes in areas with little air pollution. Such forests display a high lichen biodiversity in Japan (and elsewhere), but they have rapidly declined because of agriculture and forestry. All species included here are rare. They have most probably declined in Japan and Taiwan, and are now found mainly in protected areas. They are all good indicators of areas with high conservation values, maybe with the exception of *Graphidastra multiformis* for which habitat relations in Taiwan are as yet unknown. Only Iriomote-jima (and adjacent islands) and the Ogaswara (Bonin) Islands support true tropical vegetation in Japan. While rather large areas of oldgrowth forests still are present on Iriomote-jima, they were almost completely destroyed on the Ogaswara Islands during and after World War II. Many lichens with a tropical distribution in Japan probably occur more or less exclusively on Iriomote-jima. Large portions of this island are dedicated to a National Park, and the protection of oldgrowth forests within this park is essential for the maintenance of many lichen species within Japan (see also Thor et al. 2000). Protection of additional oldgrowth lichen-rich forests in the subtropical/tropical lowland of Japan would increase the likelihood of survival for the species included here, as well as many other rare lichens in Japan.

Chiodecton congestulum is corticolous or saxicolous in humid, oldgrowth, subtropical/tropical forests. The genus *Dichosporidium*, as in many other byssoid species, grows in habitats in which the thalli are not usually wetted by direct rainfall (usually on the lower side at the base of leaning trunks), and is readily overlooked if such habitats are not thoroughly checked. *Dichosporidium* species are in Japan often found intermixed with the similarly byssoid *Crocynia gossypina* (Sw.) A.Massal., but the latter is easily distinguished when the characteristic ascocarps with a biatorine rim are present (e.g., Hafellner 1984).

Chiodecton congestulum Nyl.

Chiodecton asahinae H.Harada 1990: 379.–Type: Japan, Mie Pref. (Ise Prov.), Uji-yamada, Ise shrine, 15 October 1934, Y. Asahina s.n. (TNS, holotype).

For other synonymy and figs, see Thor (1990). Figs also in Harada (1990).

Thallus 3–10 cm in diameter, closely attached to the substratum, surface almost smooth to verruculose, yellowish white with a greenish tinge to green, sometimes with a very thin white pruina, up to 0.4 mm thick; prothallus distinct to indistinct, brownish; medulla whitish and especially in and close to the stroma with yellow pigments, with few to numerous calcium oxalate crystals; photobiont *Trentepohlia*. Ascocarps pseudo-angiocarpic, often united, aggregated into distinctly elevated stroma with slightly to distinctly constricted bases; stromata 0.6–1.9 mm in diameter; hypothecium extending down to the substratum, hard and black; excipulum 5–15 μm thick, brown; hymenium 70–110 μm tall, without oil drops and granules; paraphysoids 1 μm wide, sparsely branched; asci 60–90 × 11–14 μm. Spores obovate, colourless, 3-septate, (28–)30–33 (–37) × (3–)3(–3) μm (Length: $\bar{X}$= 31.6 μm, SD = 1.7 μm, n = 120; Width: $\bar{X}$ = 3.0 μm, SD = 0.0 μm, n = 120) (measured on Japanese material). Pycnidia numerous, dispersed over the thallus surface; conidia filiform and curved, 11–16 × 1 μm. Chemistry: All collections contain roccellic acid, traces of at least one additional fatty acid, which in TLC runs below roccellic acid and yellow pigments (secalonic acid derivates); C−, yellow pigments K+ red, PD−, UV± grey-white; medulla K/I+ blue; hymenium I+ sky-blue rapidly turning red except the sharply delimited uppermost c. 20–35 μm which is I+ persistently deep blue, K/I+ deep blue.

Notes. Thor (1990) modified the traditional circumscription of the genus *Chiodecton*. The genus is now characterized by the following two autapomorphies: excipulum hyphae mainly anticlinally arranged and sparsely branched; and paraphysoids sparsely branched. In the field, *Chiodecton* species can be distinguished by the usually large, cretaceous thalli, which have a distinctive whitish medulla, and by the ascocarps of pseudoangiocarpic apothecia, being aggregated into stroma. Many species were excluded from *Chiodecton* s. str. by Thor (1990), and only one *Chiodecton* species, *C. congestulum*, occurs in Japan. Other species currently referred to *Chiodecton* should be transferred to other genera.

Chiodecton congestulum is a morphologically variable species, and the variation is partly geographically correlated, but the differences do not justify recognition of infraspecific taxa (Thor 1990). *Chiodecton asahinae*, recently described from Japan (Harada 1990), does not differ from the current circumscription of *C. congestulum* (Thor 1990) and is reduced to synonymy with *C. congestulum.* Spore measurements in the Japanese material of *C. congestulum* (see above) confirm that the spore size differs between populations (see Thor 1990 for measurements from different regions). The spore size in the Japanese material is (as for *Pulvinodecton kurzii*, see below) more similar to material from India and Sri Lanka than to material from Australia and Fiji (Thor 1990). This might result from parallel evolution, or, which is perhaps more likely, that dispersal and gene flow is more frequent between India/Sri Lanka and Japan than between Australia and Japan. This should be studied further by means of molecular methods. *Chiodecton* and allied genera with a wide tropical Asian distribution are probably to be found in additional areas between India/Sri Lanka and Japan in the future, but these parts of Asia are still only partly investigated for crustose lichens. An important factor in explaining the dispersal of lichen propagules (spores, soredia, isidia, thallus fragments etc.) over very long distances in Asia/Australia is probably the typhoons, frequent in the autumn. The prevailing winds in Australia are westerly (Close et al. 1978), indicating that dispersal and gene flow is more frequent between Australia and New Zealand than between Australia and Asia (with the exception of the northernmost part of Australia). This fact supports the morphological differences earlier found in *Chiodecton congestulum* (Thor 1990) and *Pulvinodecton kurzii* (Thor 1992).

The only fatty acid reported from *C. congestulum* is roccellic acid (Thor 1990). A trace of at least one additional fatty acid was found in the material from Japan and Taiwan. However, additional fatty acids are probably present also in material found outside Japan and Taiwan. *C. congestulum* is most similar to *C. sublaevigatum* Kremp. (found only within a limited area in tropical Australia), from which it is distinguished by the closely attached thallus. From *C. leptosporum* Müll.Arg. (widely distributed in Asia) it is distinguished by the yellow pigments in the medulla, and by the iodine reaction of the hymenium (I+ persistently deep blue in *C. leptosporum*). A lectotype for *Chiodecton butyraceum* Zahlbr. (a synonym of *C. congestulum*) in W was selected by Thor (1990). As pointed out by Harada (1990), an isotype is present in TNS. A second collection referred to as *C. butyraceum* by Harada (1990) from Taiwan (Changhua Prov., Lienhuachih (Rengechi), 30 December 1925, Y. Asahina F-318, (TNS) does not belong to *C. congestulum.* The material is in a bad condition (no spores can be observed outside the asci, and the number of spore septa and size of the spores are difficult to assess), but the lack of yellow pigments in the thallus and the I+ persistently deep blue hymenium indicate that it is related to *C. leptosporum.* Owing to the bad condition of the material, a definite decision concerning its taxonomic status could not be made.

Habitat. *C. congestulum* is usually corticolous, but it is striking that four out of

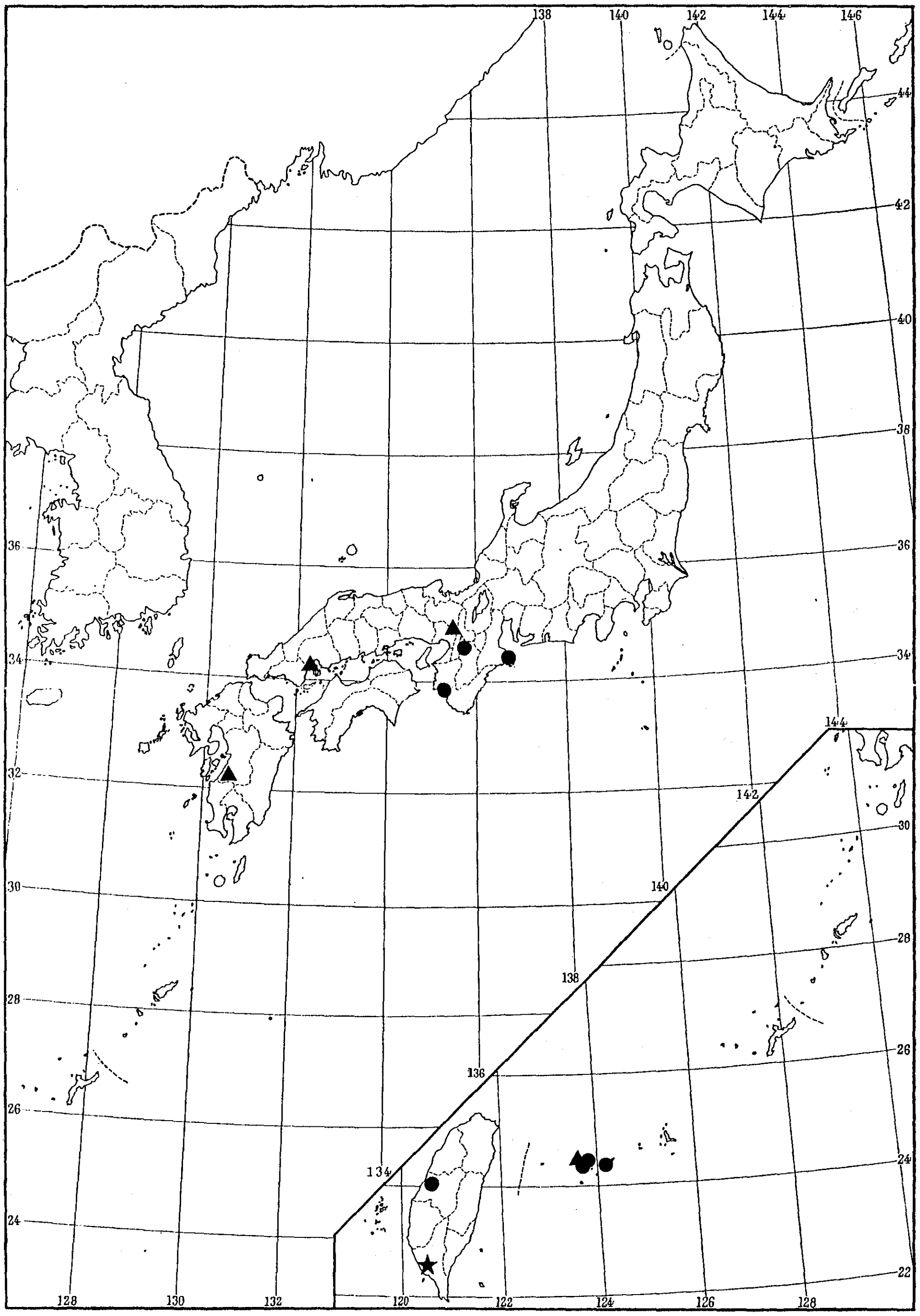

Fig. 1. Distribution of *Chiodecton congestulum* in Japan and Taiwan (● corticolous, ▲ saxicolous) and *Graphidastra multiformis* (★) in Taiwan. The locality of *C. congestulum* in Ogaswara Islands is excluded; the islands not being included on the map.

the fourteen collections from Japan are from shaded acid rocks in forests (Fig. 1). Of the approximately 115 collections included in Thor (1990) only eight were saxicolous, two from Malaysia (Borneo) and six from Australia (five from New South Wales and one from Queensland). Most saxicolous specimens are thus from New South Wales in Australia and Honshu in Japan, which might indicate that the species is more frequently saxicolous in subtropical/temperate than in tropical climates. *Chiodecton congestulum* was found once by me on rocks (G. Thor 12815), on an almost vertical rock face in a shady, oldgrowth, mixed deciduous/coniferous forest; and hence more shaded than when growing on bark. The tendency of some lichens to occur in different habitats in different parts of the distribution area is thoroughly discussed by Goward (1995). When growing on bark in Japan, *C. congestulum* is restricted to small glades in humid, oldgrowth, subtropical/tropical deciduous forests. One collection (13119) comes from the edge of a mangrove forest. *Chiodecton congestulum* does not occur on the shaded bases of trees unlike members of the genus *Dichosporidium*. No morphological or anatomical differences have been observed between corticolous and saxicolous specimens.

Distribution. *Chiodecton congestulum* is one of the most widespread *Chiodecton* species. The distribution ranges from India in the west to Fiji in the east and from Australia in the south to Japan in the north (Thor 1990). In Japan, the distribution is typical of tropical lichens that also have scattered peripheral localities in areas with a subtropical/temperate climate (Fig. 1). A few localities are found in Kyushu, whereas in Honshu additional localities occur along the coast from just west of Hiroshima and northeastwards to Osaka and the Kii peninsula south of Osaka. These localities are situated in valleys with a locally favourable subtropical climate and covered with humid oldgrowth forests (deciduous or *Cryptomeria japonica*); they harbour a species-rich and special lichen flora, which still is virtually unknown. The same distribution pattern can be found for foliicolous lichens with a subtropical/tropical distribution (Thor et al. 2000). This distribution range for tropical/-subtropical lichen was also discussed by Sato (1962) and coincides with the annul isothermal of 15 °C (Fig. 54 in Sato 1962). Almost all collections from these localities in Kyushu and Honshu, however, were made in the 1920s - 1940s. Their present status is unclear, but most have probably been destroyed by forestry, agriculture and/or urbanisation. One exception is the Inohae Valley in Kyushu (*C. congestulum* is, however, not reported from here). This is one of the very few virgin stands of meridional evergreen sclerophyllous forest remaining in Japan (Koponen 1992). Such forests also support a rich and unique bryophyte flora, and the Inohae Valley has become partly protected as a result of the efforts of Dr. S. Hattori (Koponen 1992).

Specimens examined. **Japan**. Honshu. Mie Pref. (Ise Prov.), Uji-yamada, Ise shrine, 15 October 1934, Y. Asahina s.n. (TNS, type of *C. asahinae*); Mie Pref. (Ise Prov.), Uji, 15 October 1934, Y. Asahina s.n. (TNS); Hyogo Pref. (Settsu Prov.), Minou (now Minoo), 6 April 1925, Y. Asahina 39 (saxicolous) (TNS, 2 envelopes); Nara Pref. (Yamato Prov.), Nara Park, 20 March 1949, Y. Asahina 3 (TNS); Wakayama Pref. (Kii Prov.), 1911, Ui (H); Wakayama Pref. (Kii Prov.), Nishi-muro-gun, Akitsugawa-mura, 9 April 1925, Y. Asahina 107 (TNS, 3 envelopes); Aki Prov. (Hiroshima Pref.), Miyajima-cho, Saiki-gun, 20 km SW of Hiroshima, Miya-jima (Itsuku-shima), the W to N slope of Mt. Misen from the ropeway station Shishiwa and along the trail to Omoto Park, 34°17′N, 132°19′E, alt. 200–500 m, 25 January 1995, G. Thor 12815 (saxicolous) (TNS, herb. G. Thor). Kyushu. Kumamoto Pref. (Higo Prov.), Kuma, October 1931, Y. Asahina (saxicolous) (TNS, 5 envelopes). Tokyo-to (= Tokyo Metropolis), Ogaswara Islands (Bonin Islands), Chichi-jima, Ogaswara-mura, Ogaswara-shicho, Higashi-daira, 27°04′N, 142°13–14′E, alt. c. 210 m, 27 May 1995, T. Matsumoto 3112 (HIRO).

Yaeyama Islands (Okinawa Pref.). Ishigaki-jima, Ishigaki-city administrative area, 9–10 km NNE of Ishigaki city, along the trail on the S slope of Mt. Omoto, 24°25′N, 124°11′E, alt. 200–500 m, 8 February 1995, G. Thor 13069 (TNS, herb. G. Thor); Iriomote-jima, Taketomi-cho, Yaegama-gun, along the trail in the mountains along the Urauchi river from the small camping site between two streams 7.5 km NNW of Ohara village (2.5 km NNE of the southernmost starting point of the trail) and along the trail to c. 2 km to the WNW of the camping site, 24°20′N, 123°50–51′ E, alt. 120–160 m, 11 February 1995, G. Thor 13289 (*Symplocos glauca*) (distributed in Lichenes Minus cogniti exsiccati n. 57) and 13226 (TNS, herb. G. Thor); do., from the camping site and 1 km to the south, 21 November 1997, G. Thor 15627 (herb. G. Thor); do., N of Shirahama (a small village in the NW part of the island), alt. 0–20 m, 11 January 1973, I. Yoshimura 67 (saxicolous) (TNS); do., 4 km NNE of Ohara village, at small shrine just W of the road c. 600 m W of the sea-shore, 24°19′N, 123°54′E, alt. 1 m, 9 February 1995, G. Thor 13119 (*Heritiera littoralis*) (TNS, herb. G. Thor).

Taiwan. Changhua Prov., Rengechi, 31 December 1925, Y. Asahina F-319 (lectotype of *C. butyraceum* in W, isotype in TNS).

Dichosporidium boschianum (Mont.) G.Thor

For synonymy and figs., see Thor (1990).

Thallus byssoid, sometimes sparsely squamulose, grey with a yellowish green tinge; prothallus with a whitish inner and brown outer part, medulla with a whitish layer so thin that it sometimes almost seems to be lacking interlacing with the lower part composed of brown to blackish hyphae, with few calcium oxalate granules; photobiont *Trentepohlia*; isidia scarce (e.g., 12889), coralloid; soralia not seen. Ascocarps pseudoangiocarpic apothecia, numerous, aggregated into distinctly elevated stroma with distinctly constricted bases; stromata up to 1.1 mm in diameter; hypothecium fusing with the whitish medulla, in the upper part hard and black and in the lower part soft and pale brown; excipulum 10–20 μm thick, brown; hymenium c. 100–120 μm tall; paraphysoids 1 μm wide, richly branched; asci c. 80-100 × 14–17 μm. Spores obovate, hooked, colourless, 5–8-septate, (59–)60–67 (–70) × (3–)3–4(–4) μm (Length: $\bar{X}$ = 63.4 μm, SD = 3.3 μm, n = 60; Width: $\bar{X}$ = 3.8 μm, SD = 0.4 μm, n = 60) (measured on Japanese collections). Pycnidia few; conidia bacilliform, 4–6 × 1 μm.

Chemistry: Out of the nine collections three contain protocetraric (minor), salazinic (major) and norstictic (minor) acids, four contain protocetraric and salazinic acids, one contain protocetraric acid, and one contains salazinic acid; C−, K+ red (often faint), PD+ orange to red, UV−; medulla surrounding the ascocarps K/I+ blue; hymenium I+ pale blue rapidly turning red.

Notes. The genus *Dichosporidium* is characterized by the following autapomorphy: hymenium giving a K/I+ pale blue reaction in three different iodine concentrations (0.025%, 0.25%, 1.0%) (Thor 1990). In the field *Dichosporidium* may be difficult to distinguish from the monotypic genus *Streimannia* (Australia) since both genera have byssoid greyish to greenish thalli. However, species of *Dichosporidium* may be easily recognized without microscopy by their UV− reaction. *D. boschianum* is similar to *D. brunnthaleri* (Zahlbr.) G.Thor (Africa), but the thallus of this species is grey with a bluish tinge, the isidia are unbranched, and the spores are slightly more septate and slightly longer (Thor 1990, Henssen and Thor 1998). The spore size within *Dichosporidium* is relatively uniform, and the spore size in the Japanese material is close to that found by Thor (1990) in material from other parts of Asia and from Australia. Several chemotypes are reported for most species within the genus *Dichosporidium* (Thor 1990, Henssen and Thor 1998). Four chemotypes were found in *D. boschianum* in the material from Japan and Taiwan, two of which (protocetraric and salazinic acids and protocetraric (minor), salazinic (major) and norstictic (minor) acids) have not been reported previously (Thor 1990, Henssen and Thor 1998). In the list of Specimens examined, the chemistry is indicated within parentheses with the following symbols: protocetraric, salazinic and norstictic acids (I); protocetraric and salazinic acids (II); protocetraric acid (III); salazinic acid (IV).

Habitat. In Japan *D. boschianum* is corticolous in dense, humid, oldgrowth, subtropical/tropical deciduous forests. The specimen from Taiwan was found on bark; no further information concerning the habitat is given. It is sometimes found intermixed with *D. sorediatum*.

Distribution. The species is widely distributed in Asia and also occurs in Australia and on some islands in the Pacific (Thor 1990). It is new to Japan and Taiwan.

Specimens examined. **Japan**. Kyushu. Kagoshima Pref., Amami-Oshima, Yamato-son, Oshima-gun, 8 km WSW of Naze city, near small stream, steep slope facing S to W just N of small road, 28°20′N, 129°26′E, alt. 240–260 m, 6 February 1995, G. Thor 13021 (I) (TNS, herb. G. Thor); do., 5 km NW of Nishinakama village, steep SW slope up to 300 m from the Sumiyo river just N of the road, 28°18′N, 129°22′E, alt. 150–200 m, 4 February 1995, G. Thor 12889 (I) (TNS, herb. G. Thor) and 12930g (II) (TNS). Yaeyama Islands (Okinawa Pref.). Iriomote-jima, Taketomi-cho, Yaegama-gun, along the trail in the mountains along the Urauchi river from the small camping site between two streams 7.5 km NNW of Ohara village (2.5 km NNE of the southernmost starting point of the trail) and along the trail to c. 2 km to the WNW of the camping site, 24°20′N, 123°50–51′E, alt. 120–160 m, 11 February 1995, G. Thor 13229 (II) (TNS, herb. G. Thor); do., 21 November 1997, G. Thor 15661 (herb. G. Thor); do., from the camping site and 1 km to the south, 21 November 1997, G. Thor 15646 (herb. G. Thor); do., along the trail in the mountains along the Urauchi river from 500 m N of the southernmost starting point 6 km NW of Ohara village to the small camping site between two streams 2.5 km NNE of the starting point (7.5 km NNW of Ohara village), 24°18–20′N, 123°51′E, alt. 160–220 m, 10 February 1995, G. Thor 13174 (II) (TNS), 13204 (III) (TNS, herb. G. Thor), 13205 (II) (TNS, herb. G. Thor) and 13212 (I) (TNS, herb. G. Thor; distributed in Lichenes Minus cogniti exsiccati n. 82).

Taiwan. Nantou Prov., Jitsugetsutan, 29 December 1933, Y. Asahina (IV) (TNS).

Dichosporidium sorediatum G.Thor

For figs., see Thor (1990).

Thallus byssoid, sometimes sparsely squamulose, grey with a yellowish tinge; prothallus with a whitish inner and brown outer part; medulla with a whitish layer so thin that it sometimes almost seems to be lacking interlacing with the lower part composed of brown to black hyphae, with few calcium oxalate granules; photobiont *Trentepohlia*; soralia always present, scattered, maculiform, elevated, grey with a yellowish green tinge to whitish grey, up to 1.2 mm in diameter; soredia not easily discernible, 14–28 μm in diameter. Ascocarps not present in the Japanese material but where they occur, they consist of pseudoangiocarpic apothecia, few, aggregated into distinctly elevated stroma with distinctly constricted bases; stromata up to 2.0 mm in diameter; hypothecium fusing with the whitish medulla, in the upper part hard and black and in the lower part soft and pale brown; excipulum 10–20 μm thick, brown; hymenium c. 120–140 μm tall; paraphysoids 1 μm wide, richly branched; asci c. 100–120 × 16–18 μm (Thor 1990). Spores obovate, hooked, colourless, 5–8-septate, 55–73 × 3–4 μm (Thor 1990). Pycnidia few; conidia bacilliform, 4–5 × 1 μm. Chemistry: All three collections contain protocetraric acid; C−, K−, PD+ red, UV−; medulla surrounding the ascocarps K/I+ blue; hymenium I+ pale blue rapidly turning red.

Notes. *D. sorediatum* was described by Thor (1990). It is similar to *D. boschianum*, from which it may be distinguished by its longer spores and asci, its taller hymenium, the presence of soralia, and the slightly more yellowish thallus. The Japanese material lacks ascocarps, but can still be distinguished by the presence of soralia and by the yellowish coloration of the thallus. All collections contain only protocetraric acid, which is the most common chemotype of the species (Thor 1990). Some specimens outside Japan also contain salazinic acid or salazinic (major) and norstictic (minor) acids (Thor 1990). See also the notes under *D. boschianum.*

Habitat. In Japan this species is corticolous in dense, humid, oldgrowth, subtropical/tropical deciduous forests. It was sometimes found occurring intermixed with *D. boschianum.*

Distribution. *D. sorediatum* is restricted to the east Pacific and has been reported from only three localities in Fiji (Viti Levu), and one locality each in Papua New Guinea and Vanuatu (Thor 1990). It is striking that the species has hitherto been collected only on rather small islands. The species is new to Japan.

Specimens examined. **Japan**. Yaeyama Islands (Okinawa Pref.). Iriomote-jima, Taketomi-cho, Yaegama-gun, along the 1.5 km long trail to Maryudo waterfall from the starting point at the Urauchi river 5 km SSW of Funaura village, 24°21–22′N, 123°48′E, alt. 5–60 m, 13 February 1995, G. Thor 13321 (TNS); do., along the trail in the mountains along the Urauchi river from 500 m N of the southernmost starting point 6 km NW of Ohara village to the small camping site between two streams 2.5 km NNE of the starting point (7.5 km NNW of Ohara village), 24°18–20′N, 123°51′E, alt. 160–220 m, 10 February 1995, G. Thor 13211 (TNS, herb. G. Thor) (distributed in Lichenes Minus cogniti exsiccati n. 83); do., 21 November 1997, G. Thor 15663 (herb. G. Thor); do., from the camping site and 1 km to the south, 21 November 1997, G. Thor 15647 (herb. G. Thor); do., along the trail in the mountains along the Urauchi river from the small camping site between two streams 7.5 km NNW of Ohara village (2.5 km NNE of the southernmost starting point of the trail) and along the trail to 500 m N of the southernmost starting point 6 km NW of Ohara village, 24° 18–20′N, 123°51′E, alt. 160–220 m, 12 February 1995, G. Thor 13292 (TNS, herb. G. Thor).

Erythrodecton malacum (Kremp.) G.Thor

For a morphological description, synonymy and figs., see Thor (1990) and Henssen and Thor (1998).

Distribution. The species is known from a few scattered localities in tropical Asia (Thor 1990), and one collection was found among undetermined material in TNS from Malaysia (Malaya, Pahang, Cameron Highlands, near Robinson's Fall, 2 September 1965, H. Inoue 12151). *Erythrodecton malacum* is previously only reported from one locality each in Sabah and Sarawak in Malaysia (Thor 1990), and is here reported as new to Malaya. It was searched for in Japan, but without success.

Graphidastra multiformis (Mont. & Bosch) G.Thor

For synonymy and figs., see Thor (1990).

Thallus closely attached to the substratum, cretaceous, greenish grey, up to 0.15 mm thick; prothallus distinct to indistinct, with a whitish inner and whitish to brownish outer part; medulla whitish, with few calcium oxalate crystals; photobiont *Trentepohlia.* Apothecia round to lirelliform, solitary, distinctly elevated with a slightly to distinctly constricted base, up to 0.9 mm in diameter; hypothecium extending down to the substratum, hard and black; excipulum c. 40 μm thick in the lower part narrowing to c. 5 μm in the upper part, brown; hymenium 70–90 μm tall; paraphysoids 2 μm wide, almost unbranched; asci c. 50–70 × 8–10 μm. Spores rarely observed outside asci, spermatoid, colourless, c. 2–3-septate, 35–46 × 2-3 μm. Pycnidia few, dispersed over the thallus surface; conidia filiform, curved to almost straight, 9–13 × 1 μm. Chemistry: Protocetraric acid (only in the medulla surrounding the ascocarps) and roccellic acid; C−, K−, PD+ red in the medulla surrounding the ascocarps, UV ± grey-white; medulla surrounding the ascocarps K/I+ blue; hymenium I+ persistently deep blue in the diffusely delimited uppermost c. 10–40 μm while in the lower part sky-blue slowly turning red except some strands which remain sky-blue.

Notes. The genus *Graphidastra* is distinguished by the following three autapomorphies: excipulum c. 40 µm thick in the lower part narrowing to c. 5 µm in the upper part; paraphysoid tips gradually becoming thicker from 20–30 µm down in the hymenium; spores rarely observed outside asci, especially on herbarium material older than c. five years (Thor 1990). *Graphidastra multiformis* is distinguished from the closely related *G. byssiseda* (Müll.Arg.) G.Thor (the Himalayas) by the shorter spermatoid spores and by the production of protocetraric acid.

Habitat. The species is corticolous or occasionally saxicolous in humid, subtropical to tropical forests (Thor 1990). The collection from Taiwan is on bark. No further information concerning the habitat is known.

Distribution. *Graphidastra multiformis* is widely distributed, but has been found only at scattered localities in Asia ranging from South India and Sri Lanka in the west to the Philippines in the east. It is also found in the eastern part of Queensland in Australia and at one locality each in West Samoa and Tahiti (Thor 1990). The species was searched for in Japan, but without success. It is new to Taiwan.

Specimen examined. **Taiwan**. Kaohsiung Pref., Mt. Nanfong, alt. 800–1300 m, 7 February 1965, S. Kurokawa 2769 (TNS).

Pulvinodecton kurzii (Kremp. ex Nyl.) Henssen & G.Thor

For synonymy and figs., see Thor (1992) and Henssen and Thor (1998).

Thallus closely attached to the substratum, surface smooth to verruculose, greyish green, up to 0.5 mm thick; prothallus lacking; medulla whitish, with few calcium oxalate crystals, partly ochre-coloured; photobiont *Trentepohlia*; soralia scattered, maculiform, elevated, up to 0.9 mm in diameter; soredia not easily discernible. Ascocarps a stromata with distinctly constricted bases, each stroma enclosing primarily a large apothecium that proliferates, up to 1.6 mm in diameter; disc dull brown in surface view with a striate to stellate pattern caused by the unequal deposition of secondary metabolites; hymenium divided by sterile strands and deposits of secondary metabolites; hypothecium extending down to the substratum, hard and black; excipulum c. 10 µm thick, brown; hymenium 120–140 µm tall; epithecium strongly gelatinous, 10–30 µm tall, paraphysoids 1 µm wide, richly branched; asci 90–110 × 13–15 µm. Spores fusiform, curved to almost straight, colourless, 8–13-septate, (58–)63–69(–72) × (3–)3–4(–4) µm (Length: $\bar{X} = 66.2$ µm, SD = 3.2 µm, n = 60; Width: $\bar{X} = 3.8$ µm, SD = 0.4 µm, n = 60) (measured on Japanese material). Pycnidia numerous, dispersed over the thallus surface, black; conidia bacilliform, (3–)4(–5) × 1 µm (Length: $\bar{X} = 4.0$ µm, SD = 0.4 µm, n = 120; Width: $\bar{X} = 1.0$ µm, SD = 0.0 µm, n = 120) (measured on Japanese material).

Chemistry: Both collections contain baeomysic, squamatic and rhodocladonic acids (TLC); C−, K+ yellow, PD+ yellow, UV+ white; medulla I-, K/I+ blue; hymenium I+ sky-blue slowly turning red except some strands which remain sky-blue; K/I+ persistently dark blue.

Notes. The genus *Pulvinodecton* is discussed in detail by Henssen and Thor (1998). It is mainly characterized by the ascocarps, which take the form of a stromata enclosing primarily a large apothecium that proliferates. In surface view the disc has a striate to stellate pattern caused by the unequal deposition of secondary metabolites (Henssen and Thor 1998). Rhodocladonic acid gives portions of the thallus an ochre-red colour. Baeomysic acid has only been reported from Japan (Henssen and Thor 1998). The size of the spores in the Japanese material is (as for *Chiodecton congestulum*, see above) more similar to that in material from Sri Lanka than in material from Australia (Thor 1992).

Habitat. The species is corticolous, growing in small glades in humid, oldgrowth, subtropical/tropical deciduous forests.

Distribution. *Pulvinodecton kurzii* is widely distributed in Asia and Australia, but has been recorded from few localities. It is outside Japan known only from three localities in Australia, one in Fiji, one in India and one in Sri Lanka (Thor 1992). It was reported as new to Japan by Henssen and Thor (1998).

Specimens examined. **Japan**. Yaeyama Islands (Okinawa Pref.). Iriomote-jima, Taketomi-cho, Yaegama-gun, along the 1.5 km long trail to Maryudo waterfall from the starting point at the Urauchi river 5 km SSW of Funaura village, 24°21–22′N, 123°48′E, alt. 5–60 m, 13 February 1995, G. Thor 13329 (*Quercus* sp.) (TNS, herb. G. Thor); do., along the trail in the mountains along the Urauchi river from the small camping site between two streams 7.5 km NNW of Ohara village (2.5 km NNE of the southernmost starting point of the trail) and along the trail to c. 2 km to the WNW of the camping site, 24°20′N, 123°50–51′E, alt. 120–160 m, 11 February 1995, G. Thor 13249 (TNS, herb. A. Henssen, herb. G. Thor); do., 21 November 1997, G. Thor 15658 (herb. G. Thor); do., from the camping site and 1 km to the south, 21 November 1997, G. Thor 15628 and 15630 (herb. G. Thor).

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G. トール：日本及び台湾に産する ***Chiodecton*, *Dichosporidium*, *Graphidastra*** 及び ***Pulvinodecton***

本報告は日本及び台湾に産するキゴウゴケ属 *Chiodecton* 及びその近縁属の分類学的研究の結果である．扱われた種は何れもホシゴケ科（Arthoniaceae）の固着地衣類で屋久島以南の暖帯林に生育する希産種である．ヒョウモンメダイゴケはこれまで *Chiodecton asahinae* の名前で知られていたが，東南アジアからオーストラリアの太平洋岸に広く分布する *C. congestulum* の異名となった．*Dichosporidium boschianum*（フェルトゴケ，新称）と *D. sorediatum*（マダラフェルトゴケ，新称）は日本からは初めての報告である．*Pulvinodecton kurzii*（コナダイゴケ，新称），*Dichosporidium boschianum* と *Graphidastra multiformis*（モジゴケモドキ，新称）は台湾からは初めての報告である．何れの種も年平均気温が15°C 以上の熱帯から亜熱帯に分布する．(国立スエーデン農科大学)

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